TECHNICAL SPECIFICATIONS

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SURVEY, LAYOUT OF WORK AND STAKING

NRL shall be responsible for original property boundary survey, master elevation benchmark establishment.

All works, definition of levels and center lines, slopes etc. shall be in accordance to the drawings. Stakes for all TEES, Dog-legs and Green Centers shall be 10cm. in diameter, 3 m. long above the ground, timber and fluorescent painted in Pink. All Axis of holes shall be pegged at every 20m along the axis starting from the Back TEEs. All remaining pegs shall have a minimum diameter of 5 cms. and a minimum height of 2 m above ground. In case of undulating ground longer pegs shall be provided if required.

PEGS SHALL BE COLOR CODED AS UNDER:

1. Tees centers, dog legs and Green centers	:	**3m – PINK FLOURESCENT**
2. Hole axis	:	**2m - PINK**
3. Limits of lake	:	**2m – BLUE**
4. Limits & interior of greens & tees	:	**as required – YELLOW**
5. Limits of Fairway	:	**2m – GREEN**
6. Limits of rough, semi-rough	:	**2m – BLACK**
7. Mounds and pits	:	**as required – BLACK**
8. Irrigation Lines	:	**1m – WHITE**
9. Sprinklers	:	**1m – BLACK**
10. Solenoid valves	:	**1m – RED**

All limits, boundaries etc. of Fairways, buildings, lakes, greens etc. shall be pegged out so as to clearly show the definite limits, sub grade and finished levels, corners, bends etc. All elevations proposed shall be marked on each stake. All staking shall be carried out by a professional Surveyor and all pegs shall stay in place till the grassing stage.

GOLF COURSE CONSTRUCTION SHALL NOT COMMENCE TILL THE APPROVAL OF THE STAKING IS OBTAINED FROM THE CONSULTANT / ENGINEER IN CHARGE.

MOBILIZATION

General

This work consists of mobilizing the necessary resources such as labour, equipment, and materials to begin the golf course construction process. In particular it includes the immediate transportation of personnel and equipment to the site, the establishing of construction site headquarters and storage facilities, and all other necessary requirements prior to actual construction activities.

EARTHMOVING

This operation shall be performed by a professional Earth shaper with a minimum of 3 years experience in Golf Course-Shaping.

Topsoil

It is important to understand that the topsoil, as a growing medium for the golf course turf grasses, shall greatly influence the quality of the finished golf course, therefore, special care shall be taken during topsoil handling

Type of Topsoil Material

Topsoil for fairways shall be 70% coarse sand , 20% soil from an approved source and 10 organic matter.

Stockpiling

The topsoil shall be reasonably free from subsoil, rocks, stones larger than 50mm in greatest dimension, weeds, sticks, brush and other deleterious matter. Enough topsoil shall be imported to cover the entire grassed area of the golf course with a minimum depth of 150mm. An additional amount of topsoil shall be imported for use as backfill material to ornamental plants.

Topsoil shall be stockpiled in convenient non-play, non-construction areas. Any stockpiled topsoil shall be smoothed and free of water collecting pockets so that it is in good, dry condition for distribution.

Testing

Prior to the distribution of any topsoil, each stockpile shall be qualified for suitability by laboratory chemical analysis. A 1.2 mtr. Long tube shall be used to collect 10 random samples per stockpile. The samples shall be thoroughly blended and 3.75 liters of the mixture sent to a certified laboratory for testing.

Distribution

Since the distribution of soil is critical to providing a well shaped and well drained golf course, extra care shall be taken to maintain all of the elevations, shapes, contours and appearances which were created by sub-grading and shaping activities. The topsoil shall be distributed and spread at a consistent depth over all areas affected by construction activities. A minimum of 150 mm is required over all of the fairways, and 300 mm over all green and tee slopes and green surfaces.

After the topsoil has been distributed in all areas, it shall be graded and smoothed so that there are no water holding pockets. Surface drainage shall follow the plans. Natural drainage shall be used wherever possible to enhance the surface drainage of the golf course.

The topsoil shall be cleaned of all stones, roots, or any debris or unacceptable material greater than one (1) inch in diameter, by stone pickers, rakes, drags, or other equipment or devices which shall not disturb the topsoil grade, depth or composition, and accomplish the results desired by the golf course Consultant / engineer in charge. Also during this cleaning process, no water holding pockets shall be created and the surface shall be smoothed to provide for good surface drainage.

After the topsoil redistribution process has been completed and prescribed soil amendments, as called for by laboratory test results, shall be applied prior to planting.

Subsoil

Unclassified

Excavation for the golf course lakes shall follow the plans provided by the Consultant / engineer in charge . Subsoil to be used as fill for the golf course shall be excavated from the lakes as described in the relevant clause . Additional subsoil as required may be imported fill material with the following physical and chemical properties:-

The EC(Electrical Conductivity) shall be less than 50 mmhos/cm. The SAR(Sodium Absorption Rate) shall be less than 25. The boron shall be less than 4.0 p.p.m.

Lake Excavation Material

Subsoil fill shall be excavated from the designated lake area. Excavated material for the construction of the golf course to be used for the construction of features, including greens, tees, bunkers, mounds, and any other golf course features, shall be suitable for golf course construction purposes and shall be free of peat, muck, rock or any components detrimental to the construction of the golf course. All geophysical conditions and soils shall be tested for their suitability for use on the Golf Course. Subsoil shall be qualified through periodic field testing.

Testing

Periodic chemical testing, especially for the SAR ratio and boron, shall be completed as stockpiled material is field qualified to maintain subsoil uniformity. A 1.2 mtr. Long tube shall be used to collect 10 random samples per stockpile. The samples shall be thoroughly blended and 3.75 liters (1 gal.) of the mixture sent to a certified laboratory for testing.

Embankment/Fill/Compaction

Areas that are to be filled, as shown on the plans, shall be filled with lake excavated subsoil and imported fill material. The embankments or fills shall be so constructed that they do not slip, slide, slump, or move from their deposited location. The fill areas shall be sufficiently compacted to 85% compaction to prevent future settling or movement. The fill areas shall be constructed of materials free of stumps, logs, roots, or any other perishable, biodegradable organic or non-toxic materials.

In areas where larger amounts of rock versus soil is encountered for shallow fills, the fills shall be compacted with a vibratory roller so that voids, pockets and bridging is minimized or eliminated.

If the fill material is too dry to attain proper compaction then water shall be used to attain the proper moisture level necessary for adequate compaction. All fill areas are to be filled and rough shaped within 150mm of the proposed finished sub-grade as shown on the plans. All cut areas are to be excavated to within 150 mm of finished sub-grade. All cut and fill areas must follow closely the 'grading plan'. Rough shaping consists of bulldozing into place and form the general golf course elevations, shapes, forms, contours and appearances. The tolerance differential for earthmoving and rough shaping is plus or minus 150mm.

SHAPING

Since the shaping of the golf course ultimately reflects the final elevations, shapes, contours and appearances of the golf course less the depth of the topsoil, it is mandatory to follow the contour plan and the prescribed field adjustments. Field adjustments of the elevations, shapes, forms, contours and appearances shall be part of the shaping function and is considered a normal part of golf course construction. During the golf course construction, process, the Consultant / engineer in charge, shall have access to the shaping crawler tractor to either operate the equipment himself, or direct the tractor operator as to the desired shapes and appearances.

Phase I – General Shaping

Golf Course shaping consists of bulldozing into place and form more exact golf course elevations, shapes, forms, contours and appearances. The equipment operator for this phase of shaping shall have previous golf course shaping experience and shall be approved by the Consultant / engineer in

charge. After more exact golf course elevations etc., are shaped, the Consultant / engineer in charge shall review and approve the same prior to moving to the next step of construction activity for any given area. All field adjustments as directed by the Consultant / engineer in charge are made prior to proceeding to the next phase of construction for that given area. This phase of shaping brings the golf course to the final elevations, shapes, forms contours and appearances less the depth of the topsoil. During this phase there shall be adjustment and refinement for the enhancement of the golf course, especially for strategic and drainage purposes.

Phase II – Finish Shaping

Finish shaping consists of general shaping refined to the degree that it is a mirror image of the finished and grassed golf course as drawn, including field adjustments, and less the topsoil. All areas are shaped and graded in a manner that there are no water holding areas and all elevations, shapes, form, contours and appearances, tie into the existing surrounding undistributed land as to simulate that the new golf course has always been part of the natural landscape.

After the more exact golf course elevations etc., have been shaped, the Consultant / engineer in charge shall review the shaping and get field adjustments made prior to moving to the next step of construction activity for any given area. This phase of shaping brings the golf course to the final elevations, shapes, form, contours and appearance, less the depth of the topsoil. During this phase there shall be adjustment and refinement for the enhancement of the golf course, especially for strategic and drainage purposes. These field adjustments are a normal part of golf course construction and these adjustments shall not change the shaping price.

The work is normally performed with a small Caterpillar D-3 size crawler tractor with a six(6) way hydraulic bulldozer accompanied by a 45 HP industrial tractor with a box blade or leveling blade. An experienced equipment operator for golf course shaping is mandatory for finished shaping.

All elevations, shapes, form, contours and appearances established during the general shaping and golf course shaping shall be reproduced as a result of Finish Shaping. The same elevations etc., must be intact prior to final spreading and smoothing of the topsoil prior to grassing.

All excavated and filled areas, as indicated shall be sub-graded and shaped to elevation, contours, shapes and appearances as shown on the plans and in a manner that no water holding areas are created.
On occasion, due to golf course design concepts, some areas cannot surface drain properly. These areas shall be drained by field drains which are provided for in the drainage section of these Specifications.

The location of localized field drainage shall be indicated on the construction drawings but this location may be adjusted or moved in the field during the shaping process.

Shaping for the greens and tees shall be consistent with all other shaping, but it must be remembered that no topsoil shall be spread on the putting surfaces or the teeing surfaces. Additional construction activities performed on the greens and tees are fully described in the Features Construction section of these specifications.

If any shaped golf course area or feature is disturbed by any other construction activity, including additional golf course construction, the disturbed areas shall be reshaped to conform with the original shaped and approved forms.

FEATURES CONSTRUCTION

Putting Greens Construction

The following are the "USGA Recommendations for a Method of Putting Green Construction" as per the 1993 USGA Green Section manual.

The Sub-grade

The slope of the sub-grade shall conform to the general slope of the finished grade. The sub-grade shall be established approximately 400mm below the proposed surface grade and shall be thoroughly compacted to prevent further settling. Water collecting depressions shall be avoided. A 1 m collar shall be constructed around the green to the same standards as the putting surface itself

Drainage

A subsurface drainage system is required in USGA greens. A pattern of drainage pipes shall be so that the main line(s), with a minimum diameter of 4 inches PVC/corrugated plastic pipe (100mm), is placed along the line of maximum fall. Four-inch (100mm) diameter laterals shall run up and across the slope of the sub grade, allowing a natural fall to the main line. Lateral lines shall be spaced not more than 15 feet (5m) apart and extended to the perimeter of the green. Lateral lines shall be placed in water-collecting depressions shall they exist. At the low end of the gradient, adjacent to the main line's exit from the green, drainage pipe shall be placed along the perimeter of the green, extending to the ends of the first set of laterals. This shall facilitate drainage of water that may accumulate at the low end of that drainage area.

Gravel for piped drain lines shall be ¼" to 3/8" (6mm to 9mm) diameter non calcareous material. Gravel shall be tested for aggregate stability, size and hardness and determined suitable for use in drainage trenches and below the greens soil mixture. Drainage trenches 200mm wide and a minimum of

300mm deep shall be cut into a thoroughly compacted sub-grade so that drainage lines slope uniformly.
Soil from the trenches shall be removed from the sub-grade cavity.

All drainage pipe shall be placed on a gravel bed in the trench, assuring a minimum positive slope of 0.5 percent. Drain pipes shall be placed in the trench with the holes facing down. Backfill shall be done with additional gravel, taking care not to displace any of the drainage pipes.

Gravel and Intermediate Layers

Grade stakes shall be placed at frequent intervals over the sub-grade and marked them for the gravel drainage blanket layer, intermediate layer and root zone layer. The entire sub-grade then shall be covered with a layer of clean, washed crushed stone or gravel to a minimum thickness of four inches (100mm), conforming to the proposed final surface grade to a tolerance of +/- 1inch.

Soft lime stones, sandstone or shale shall not be accepted. Questionable materials shall be tested for weathering stability. The need for an intermediate layer is based on the particle size distribution of the root zone mix relative to that of the gravel. When properly sized gravel (see Table 1) is available, the intermediate layer is not necessary. If the properly sized gravel cannot be found, an intermediate layer must be used.

(a) Selection and Placement of Materials when the Intermediate Layer is Used

Table 1 describes the particle size requirements of the gravel and the intermediate layer material when the intermediate layer is required. The intermediate layer shall be spread to a uniform thickness of between two and four inches (50 to 100mm) over the gravel drainage blanket (e.g., if a 3-inch depth is selected, the material shall be kept at that depth across the entire area), and the surface shall conform to the contours of the proposed finished grade.

Table 1. Particle size description of gravel and intermediate layer materials.

MATERIAL	DESCRIPTION
Gravel- Intermediate layer is used	No more than 10% of the particles greater than ½" (12mm).
	At least 65% of the particles between ¼" (6mm) and 3/8" (9mm)
	Not more than 10% of the particles less than 1mm.
Intermediate Layer Material	At least 90% of the particles between 1mm and 4mm.

(b) Selection of Gravel when the Intermediate Layer is Not Used

If an appropriate gravel can be identified (see Table 2), the intermediate layer need not be included in the construction of the green.

Selection of this gravel is based on the particle size distribution of the root zone material. The Consultant / engineer in charge and/or construction project manager shall work closely with the soil testing laboratory in selecting the appropriate gravel. Either of two methods may be used:

i) Send samples of different gravel materials to the lab when submitting samples of components for the root zone mix. As a general guideline, look for gravel in the 2mm to 6mm range. The lab test shall determine the best root zone mix, and then shall test the gravel samples to determine if any meet the guidelines outlined below.

ii) Submit samples for the components for the root zone mix, and ask the laboratory to provide a description, based on the root zone mix tests, of the particle size distribution required of the gravel. Use the description to locate one or more appropriate gravel materials, and submit them to the laboratory for confirmation.

Gravel meeting the criteria listed in Table 2 shall not require the intermediate layer.

The criteria based on engineering principles which rely on the largest 15% of the root zone particles “bridging” with the smallest 15% of the gravel particles. Smaller voids are produced, and they prevent migration of root zone particles in the gravel yet maintain adequate permeability. The D15 (root zone) is defined as the particle diameter below which 85% of the soil particles (by weight) are smaller. The D15 (gravel) is defined as the particle diameter below which 15% of the gravel particles (by weight) are smaller.

- For bridging to occur, the D15 (gravel) must be less than or equal to five times the D85 (root zone).

- To maintain adequate permeability across the root zone/gravel interface, the D15 (gravel) shall be great than or equal to five times the D15 (root zone).

- The gravel shall have a uniformity coefficient (Gravel D90/Gravel D15) of less than or equal to 2.5

Furthermore, any gravel selected shall have 100% passing a ½” (12mm) sieve and not more than 10% passing a No.10(2mm) sieve, including more than 5% passing a No.18 (1mm) sieve.

Table 2. Size recommendations for gravel when intermediate later is not used.

GRAVEL CRITERIA	RECOMMENDATION
Bridging Factor	D15 (gravel < 5/x/D85 (root zone)
Permeability Factor	D15 (gravel < 5/x/D15 (root zone)
Uniformity Factors	D90 (gravel)/ D15 (gravel) < 2.5
	No particles greater than 12 mm
	Not more than 10% less than 2mm
	Not more than 5% less than 1mm

Soil Selection

If soil is used in the root zone mix, it shall have a minimum sand content of 60%, and a clay content of between 5% and 20%. The final particle size distribution of the sand/soil/peat or organic matter mix shall conform to that outlined in these recommendations, and meet the physical properties described herein. Sand for the root zone mix shall be high quality silica sand.

Organic Matter Selection

Organic sources such as well decayed farm yard manure, rice hulls, finely ground bark, saw dust, or other organic waste products are acceptable if composted through a thermophilic stage, to a mesophilic stabilization phase, and with the approval of the soil physical testing laboratory. Composts shall be aged for at least one year. Furthermore, the root zone mix with compost as the organic amendment shall meet the physical properties as defined in these recommendations.

Composts can vary not only with source, but also from batch to batch within a source. Extreme caution must be exercised when selecting a compost material. Unproven composts must be shown to be non-phytotix using a bent grass or Bermuda grass bioassay on the compost extract.

Inorganic and Other Amendments – Inorganic amendments (other than sand), polyacrylamides, and reinforcement materials are not recommended in the USGA root zone mixes.

Physical Properties of the Root Zone Mix – The root zone mix shall have the properties summarized in Table 3.

Table 3. Physical properties of the root zone mix.

Physical Property	Recommended Range
Total Porosity	35% - 55%
Air-filled Porosity (at 40cm tension)	20% - 30%

Capillary Porosity (at 40 cm tension	15% - 25%
Saturated Conductivity Normal Range: Accelerated Range:	 6-12 inches/hr (15-30 cm/hr) 12-24 inches/hr (30-60 cm/hr)
Organic Matter Content (by weight)	1% - 5% (ideally 2% - 4%)

Under the heading Saturated Conductivity in Table 3, Normal Range refers to circumstances where normal conditions prevail for growing the desired turfgrass species. Accelerate range refers to conditions where water quality is poor, cool season turfgrass species are being grown out of range of adaptation, or dust storms or high rainfall events are common.

Particle size distribution of root zone mix:

Name	Particle diameter	Specification
Fine gravel	2.0 – 3.4 mm	Not more than 10% of the total particles in this range incl. A max. of 3 % fine gravel (preferably none)
Very coarse sand	1.0 – 2.0 mm	
Coarse sand	0.5 – 1.00 mm	At least 60% of the particles must fall in this range
Medium sand	0.15 – 0.25 mm	
Fine sand	0.15 – 0.25 mm	Not more than 20% of the particles may fall in this range
Very fine sand*	0.05 – 0.15 mm	Not more than 5%
Silt*	0.002 – 0.05	Not more than 5%
Clay*	Less than 0.002%	Not more than 3%

* The sum total of these particles shall not exceed 10%

Chemical Characteristics:

- Calcium(Ca) Mgs per litre 650.00
- Magnesium (Mg) mgs per litre 125.00
- Sodium(Na) mgs per litre 510.00
- Sulphate (SO4) mgs per litre 1800.00
- Chlorides (Cl) mgs per litre 500.00
- pH value at 25 celsius 7.00
- Electrical conductivity MS/CM at 25 celsius 3.00
- Sodium absorbtion ratio SAR 3.50

Exchangeable absorption percentage(ESP)
(Neutral Normal Ammonium

Acetate Extract)	5.00
Free carbonites(as CO2)	
% per weight of dry soil	20.00
• Hot water soluble boron(B) PPM	1.00
Phosphorus (as PO4)	
(1.5m Ammonoium nitrate extract-	
half hour shake) PPM	20.00
Potassium(asU)	
(1.5m Ammonoium nitrate extract-	
half hour shake) PPM	40.00
Magnesium (as Mg)	
(1.5m Ammonoium nitrate extract-	
half hour shake) PPM	300.00

RELATED CONCERNS

IT IS ABSOLUTELY ESSENTIAL TO MIX ALL ROOT ZONE COMPONENTS OFF-SITE.

No Valid justification can be made for on-site mixing, since a homogeneous mixture is essential to success.

Arrangements shall be made with a competent laboratory to routinely check gravel and/or root zone samples brought to the construction site. It is imperative that these materials conform to the recommendations approved by the laboratory in all respects.

Some tests may be performed on site with the proper equipment, including sand particle size distribution.

Care shall be taken to avoid over shredding the organic matter/peat, since it may influence performance of the mix in the field. Organic matter/ Peat shall be moist during the mixing stage to ensure uniform mixing and to minimize organic matter/peat and sand separation.

Fertilizer shall be blended into the root zone mix. Lime, phosphorus and potassium shall be added based on a soil test recommendation.

Top Mix Covering, Placement, Smoothing and Firming.

The thoroughly mixed root zone material shall be placed on the green site and firmed to a uniform depth of 300mm with a tolerance of +/- ½ inch. Be sure that the mix is moist when spread to discourage migration into the gravel and to assist in firming.

Sterilization

Sterilization of the root zone mix by fumigation shall be carried for root zone mix for greens, tees, collars and all areas except fairways and roughs. The

complete root zone mix shall be drenched with Formalin (1part in 50 parts of water)

TEES CONSTRUCTION

Tees shall be built to follow the Grading Plan to ensure that tee forms and size blend into natural terrain. To further ensure that each tee is located in the best possible location, field adjustments may be necessary. Therefore, the Consultant / engineer in charge reserves the right to make field adjustments relative to tee locations after the tees have been surveyed and staked per plan and before tee construction has begun.

In general, all fill areas shall be compacted so that no future settling shall occur. Care shall be exercised that no water shall be tapped around tees.

Tees shall be “capped” or “topped” with a minimum of 150mm of the same sand mix used as root zone mix for greens construction. The sub-grades shall be constructed with sufficient pitch (.5% minimum) to allow sub-drainage, but finished surface grades shall be perfectly level. Prior to grassing, the tee surface shall be compacted, dragged completely level and approved by Consultant / engineer in charge.

BUNKERS CONSTRUCTION

General

All bunkers shall closely follow the size, shape, and depth indicated on the Drawings. Shall there be any questions concerning the degree or depth of slope on any portion of the bunkers, the Consultant / engineer in charge shall be consulted immediately. All bunkers shall be shaped so that there are no water holding areas and all bunkers shall have a positive surface and subsurface drainage to eliminate any casual water. All slopes shall be constructed so that maintenance can be accomplished with normal golf course mowing equipment. The sand/grass relationship shall be defined and marked by the Consultant / engineer in charge. All bunkers shall drain internally with no water holding areas.

Fairway Bunkers.

Bunkers shall follow the Consultant / engineer in charge’s outline in size, shape, and depth, and shall be clearly visible from the tees. Drainage trenches for all bunkers shall extend into the low area of each bunker lobe or as directed by the Consultant / engineer in charge. The trenches shall be 200mm in width by 300mm in depth, the bottom of which shall produce a constant grade of not less that 0.5% slope. The trenches shall extend to lakes, streams, or other non-play areas and drained with 100mm pipe as specified in the greens. Trenches draining into nearly level non-play areas

shall end in pits dug 1800mmX1800mmX1800mm. These pits shall be filled with gravel and 600mm of topsoil. Washed gravel of 6 to 9mm diameter shall be evenly spread 75mm deep in the bottom of all trenches.

Upon the gravel blanket shall be laid the same pipe used on the greens. The trenches shall then be covered with a pervious membrane to stop soil movement into them, prior to the completion and placement of sand. The portion outside the bunker shall be covered with topsoil.

Green-side Bunkers

Bunkers shall follow the Consultant / engineer in charge's outline in size, shape and depth. They shall be drained in the same manner as fairway bunkers. The bunker pipe shall never intercept the green pipe off the putting surface. **NO bunker pipe shall be drained through the putting surface.**

Note: Grassing with regard to all trap and bunker banks and slopes shall be sodden.

Bunker Sand

Sand for the bunker shall be a natural white, and of a consistency approved by the Consultant / engineer in charge, unbleached silica sand of the following analysis:

Sieve Analysis - Sand	
16 mesh	3.91% Retainage
20 mesh	5.22% Retainage
30 mesh	14.59% Retainage
40 mesh	26.45% Retainage
50 mesh	32.50% Retainage
70 mesh	14.12% Retainage
100 mesh	2.86% Retainage
140 mesh	.36% Retainage

The material shall be spread evenly throughout the bunker at a settled depth not less than 4" and not more than 6" in a manner suitable to the Consultant / engineer in charge.

LAKE CONSTRUCTION

Waterproof Membrane

The lakes shall be lined with a high density polythene waterproof membrane or approved equal. The membrane shall extend along the full interior of each lake and shall be turned down into an edge trench 300 mm wide by 300mm

deep. The edge trench shall be backfilled and thoroughly compacted to fully secure the waterproof membrane.

Washed Sand

A 100 mm thick layer of washed sand shall be spread over the waterproof membrane as indicated in the drawings.

Cobbles

Cobbles shall be laid to line the lake as specified in the drawings. Cobbles shall be 20mm to 100mm stone. The mixture shall be random.

Aeration fountains

Each of the aeration fountains shall have a two tiered display of aerated columns of water. The vertical control jet of 8 meters in height shall be surrounded by 6 arching nozzles with a height of 4 meters and a diameter spread of 4 meters.

The final sizes of equipment and connections shall be based on manufacturers' standard equipment complying with intended purpose. The float shall be 1.8 meter OD, 1.2 meter ID, roto-cast poly-ethylene, color black to resist fade and deterioration. Superior weather ability complete with ballast tanks (valves and inlets) to obtain correct buoyancy/submersed level shall be used. Piping shall be PVC schedule 40 or equal approved. The pump shall be 11.2 KW submersible, stainless steel, Resistant to wear and tear, corrosion and abrasion, stainless steel screen, motor overload protection 380 Volt, 3 phase 35 amps. The pump efficiency performance range shall be 1300 lpm to 1800 lpm.

Lighting of the fountain shall be 220V Tungsten halogen 4-1000W, 20 amps , bronze submersible type with clear convex adjustable angle and stainless steel fastenings. Junction boxes shall be submersible type bronze, potted electrical connections, brass strain, relief chord seal and shall be suitable for submersible installations. All electrical connections shall be epoxy sealed.

The Electrical control panel shall have a weather proof, lockable, UV resistant enclosure, complete with ground fault transient short circuit and pump overload protection. Also included shall be a 24 hour timer, photocell control (for light fixtures) and wind control device).

The nozzle jets shall be fitted with integral swivel and air to water ratio adjustment collar and shall be made of brass and cast bronze. A single spray jet shall be aerated with 65mm orifice . The six arching jets shall be aerated with 40mm orifice.

IRRIGATION SYSTEM

General

The irrigation system has been conceptually designed based on the graphic representation of the golf course layout and the golf course grading plans. There shall be situations in the field that shall require deletion or addition of irrigation heads.

General Installation Requirements

The work covered in this section defines the general installation requirements of a complete underground golf course irrigation system. Sprinkler lines, head valves, controllers, etc., shown on the drawings are essentially diagrammatic. The exact location for the installation of components of the system shall be adjusted and established on site.

Technical Installation Requirements

The work covered under this section outlines and defines all specific and required materials that shall be necessary for the complete installation of the designed and specified underground irrigation system.

The system utilizes satellite controllers with 16 or more stations per controller, with all designed areas of coverage being watered. The satellite controllers and central (master controller if required) shall be located and installed where indicated on the Irrigation Plans.

Drawings of Record

The irrigation plan and specifications submitted by the golf course architect/ Consultant / engineer in charge shall be used as a basis for the plan of record. All installation modifications or changes in materials, equipment or location shall be recorded on the drawings of record.

The plan of record shall include:

a) Type, quantity and location of all materials and equipment installed.

b) Upon completion of the work drawings of record showing the total completed irrigation system as installed shall be prepared.

Routing

The routing and staking shall be in general accordance with the irrigation routing plan. Prior to any trenching, construction or installation of the irrigation system components, the best location of runs of pipe, sprinkler heads, valves, controller slabs etc. shall be staked out.

Pipe lines to be laid are shown diagrammatically on the IRRIGATION PLAN. Best routing and placement of heads to insure the proper and designed coverage shall be worked out at the site. Pipe lines and heads shall be a minimum of two (2) feet from the putting surface and no line shall run through the bed of any sand trap or under any green (putting green) surface.

Trenching and Back-filling Requirements

All trenching, installation of pipe, valves, sprinkler heads, construction of thrust blocks, etc., shall be in accordance with the manufacturer's recommended installation requirements or as soil conditions dictate.

Mechanical trench diggers shall provide trenches with straight sides and shall be no wider at any point than is necessary to lay and bed the pipe properly. The depths to which all pipe is to be laid shall be determined by the golf course architect/Consultant / engineer in charge, complying with the local conditional requirements. Approximate minimum depths of cover over all mainline pipe shall be 650mm and the laterals 450mm.Special care shall be taken in hand-backfilling and tamping over pipes. Throughout the installation phase, repair of trenches eroded by rainfall and runoff or acts of vandalism shall be undertaken.

Piping and Installation Requirements

All piping (unless specified otherwise) shall be unplasticized polyvinyl chloride (PVC), ring-tite, Class 4 as specified on the drawings. Solvent weld type uPVC pipe shall be permitted on Sizes 40mm through 160mm. All PVC pipe is to be installed in accordance with the manufacturer's instructions and recommendations.

Depth of pipe installation shall in accordance with the minimum depths of cover specified in the Trenching and Backfilling Requirements section of these specifications. All street and road pipe crossings shall be handled in accordance with local codes.

Sprinkler Heads.

Rotor sprinklers for greens, fairways and roughs shall be without valve in head water lubricated gear drive, in-ground type. The sprinkler shall be available in full and adjustable part circle versions with interchangeable color-coded nozzles and manual operation at the head. The sprinkler shall have a factory set pressure regulator of 80 psi.

The sprinkler shall be available with arc adjustable from top. The sprinkler shall have a 3.25" pop up height to raise the sprinkler above the surrounding turf.

The part-circle sprinkler shall have adjustable arc coverage of 30 to 345. Arc adjustment can be performed with or without the rotor in operation and shall require only a flat-blade screwdriver. The part-circle rotor shall rotate through a 180 arc in two minutes or less. Rotation through 360 shall be four minutes or less for the full-circle sprinkler.

The sprinkler shall be fully serviceable from the top without requiring special tools. The internal assembly shall be retained in the case by a plastic snap ring. The rotor shall have a bearing guide that allows water to flush around the riser stem as it pops up and seals against the riser when it is fully raised. The retract spring shall be of stainless steel and of sufficient force for positive pop-down.

The nozzle housing cover of the rotor shall indicate the model, identify the installed nozzle and have an arrow to indicate the position of the nozzle, and shall provide a positive seal against debris when the rotor is not in operation. The housing shall be installed with one of six color-coded nozzles. The nozzle shall be tested per ASAE s398.1 and be verified to deliver scheduling coefficient of 1.2 or less and a Christians coefficient of uniformity of 90% or greater at the specified spacing.

The rotor body shall be molded of engineering grade plastic and shall have a double-wall construction female (NPT, BSP or ACME) bottom inlet.

The sprinkler shall have a spring-loaded SEAL-A-MATIC hold-back device in the base of the case. The device shall hold back at least 10' (3,1 m) of elevation.

The rotor case shall have a top diameter of 4.25" (10,8 cm) and an overall height of 9.63" (24,5 cm). The case shall have a 1" (2,5 cm) NPT, BSP or ACME threaded inlet.

The sprinkler head assembly shall be connected to the lateral line by installing a SCH 80 three-way “O”-ring swing joint, or triple swing joint as shown on detail.

All installed sprinkler heads and boxes shall be marked with “Irrigation Flags” or stakes.

Sprinkler heads and boxes shall be set 3” above grade where turf has yet to be established. All rotary pop-up sprinklers and quick coupler valves, as

specified on the plan, shall be attached to the irrigation system piping with swing joints at the location and grades indicated on the plan.

Fittings.

All fittings for uPVC pipes shall be compatible with uPVC pipes and shall include all elbows, bends, tees, reducers, reducing bushes, male threaded adapters as required for the system. All solvent weld joints shall be made with solvent cement.

Isolation Valves

Lateral isolation valves three inches (3”) and smaller shall be bronze threaded, class 150 W.O.G. ball valves.

Gate valves four inches (4”) and larger shall be cast iron high resilient wedge, epoxy coated iron inside and out, with a two inch 2” non-rising operating nut.

Each valve placed underground shall be placed in a valve box. The box cover shall be marked “WATER”

For the operation of underground valves with nut mounted stems, one (1) socket wrench for each size of valve nut in the system shall be furnished. Valve wrenches shall be four feet (4’) in length and complete with sockets to fit two inch (2”) square nuts. All wrenches shall have tee handles and be constructed of steel pipe with welded connections.

The location and type of all valves are shown on the layout routing plan. The implementation of the plan shall be followed as closely as possible.

Air release valve

Air release valves shall be 2” dia, single orifice, cast iron body designed for the inflow/outflow of air in bulk. The valve shall be pressure rated for 200 psi. The body shall be epoxy coated for protection against corrosion. The float shall be stainless steel or ABS plastic. Provide 2” isolating ball valve upstream of the air valve.

Air release valves shall be installed at field chosen mainline high-points and connected with the mainline with a saddle.

Quick Coupling Valves and Keys

Quick coupling valves shall be solid bronze or brass construction with metal cover and 1 1/4" inlet. The seat disc plunger shall be spring loaded to keep valve closed at zero inlet pressure.

Coupler shall be removable from top while valve is under pressure and shall be one piece design with single slot. The valve shall be operated with plug in type special cast bronze or brass coupler key with single lug.

Solenoid Control Diaphragm Valves

The remote control vale shall be a normally closed 24 volt A.C. 50/60 cycle solenoid actuated globe pattern diaphragm type. The valve shall be capable of continuous operating pressure of not less than 200 psi. The valve body and bonnet shall be constructed of heavy cast brass.

Electrical Services

NRL shall furnish the electrical services necessary for supplying required electrical voltage to the pumping system and electrical control system at the points designated on the plans.

Wire

All wiring (control lines) shall be assembled, connected and installed in accordance with the manufacturer's instructions and recommendations.

Care and caution shall be taken in making splices and connections and each splice or connection shall be made permanently waterproof.

All wire shall be installed in trench lines and shall not be yanked, stretched, or excessively pulled during installation. Wire shall be laid on a firm, even bed which shall support the entire length of the wire installed.

All wiring crossing streams, lakes, lagoons, bridges or routed under roads, etc. shall be placed in PVC pipe or conduits and all joints shall be made waterproof.

Wire shall be laid on the same side of the trench, as much as possible, throughout the system and shall be bundled and tied together every 3 meters.

Power supply at indicated sources is to be no less than 220 volt, 50 cycle, 20 amp, with a source supply and service hook-up shall be made available.

Valve control and common wires from satellite/remote controllers shall be 1.5 mm2 two core stranded conductor, direct burial wire.

On systems containing master to satellite control, control wiring from the master to satellites shall be as recommended and approved by the controller manufacturer.

Control Equipment

The location of all satellite controllers shall be staked in the field The control equipment is a computerized large turf irrigation controller utilizing electronics and computer software design. A typical system consists of a Central control, a communications system and satellite controllers. The system offers true two-way communications over twisted pair wire, or telephone lines.

The satellite controller shall be a 8 or 16-station control unit, with an add on in multiples of 8 upto 48 stations. Each station shall have built-in surge protection. The satellite controller shall be capable of operating up to 4 simultaneous programs (stations). The satellite controller shall be capable of accepting the following nominal primary input voltages : 220V., 50HZ

The satellite controller shall have a minimum of 6 independent programs. Each program shall have the ability to be independently scheduled. Each program shall have 12 starting times. Stations may be independently assigned to multiple programs.

The satellite controller shall have an “OFF” mode to allow the controller to be temporarily disabled without removing any program data.

The central controller shall utilize a personal computer-based, user-friendly mouse/key/board control system capable of transparent multiple functions for simultaneous irrigation control and business use. The computer hardware, including personal computer, color monitor printer, keyboard, mouse and cables, shall be included as a part of the control system.

The central controller shall provide two-way communications to satellites via (twisted pair) wire.

The central controller shall have the ability to operate up to 6 irrigation programs. Each program shall be independently scheduled. Each program shall have at least 12 starting times. Each program shall be capable of being independently disabled (set into “OFF” mode).

The central controller shall have the ability to calculate actual station cycle time based on user input of total time required, operational E.T., manual adjustment factors, number of starts, and number of repeat cycles.

The central controller shall have the ability to

manually adjust (percentage increase/decrease) by station program, satellite, group, and/or for the entire system. System adjustment factor may be input via actual percentage or operational E.T.

The central controller shall manage system flow by automatically generating the appropriate (satellite-based) program starting times based on program priority and hydraulic limits set for each satellite, or group of satellites.

The central controller shall have the ability to manually start programs for an individual satellite. The central controller shall have the ability to start a multi-manual cycle in a satellite, running up to 4 stations simultaneously with each stations having an independent running time.

Satellite controllers shall be completely automatic for normal operation. They shall also have the capability of being operated manually. Satellite controllers are to be mounted and wired according to the manufacturer's instructions and recommendations, and, in accordance with local and state electrical code requirements.

Satellite controllers shall be mounted on concrete pads of sufficient size and strength to adequately support the controller and provide the stability necessary to protect them from weather and vandalism.

All controllers shall be grounded by copper clad grounding rods. The ground shall have a resistance reading of 10 OHMS or less.

Valve Boxes

The valve box to be constructed of high density polyethylene, glass reinforced polypropylene or ABS and to have bolt down or lockable lid. The valve box cover to be green in color and each valve box to be stenciled with valve and controller numbers for identification. Valve boxes shall be installed on all gate valves, air release valves, electric wire jn.,controller earthing copper rods.

Valve box shall be installed (3-5) cm above final ground level, and shall have a solid base under them, with gravel of (15) cm deep under the RCV and filter for to drain excess water during service & repairs.

Set and Adjustment of the Irrigation System

This includes the programming and adjustment of all pumps, controllers, sprinkler heads, pressure regulators, valves, etc. All of the above work shall be in conjunction with the superintendent of the golf course or other irrigation personnel.

Clean Up

Waste materials, crates, rubbish, cartons and all trash shall be removed or disposed of in all work areas at the end of each working week.

The Materials storage site, fuel tanks or trucks and all construction equipment shall be centralized and left in an orderly fashion at the end of each working week.

PUMP STATION

General

To provide a single source responsibility for the manufacture, warranty, service and operation of a prefabricated, skid mounted. Pumping system shall conform to the following specifications or equal and approved. This specification covers the minimum requirements, however, it shall not be construed as all inclusive. The manufacturer shall supply a complete set of general arrangement drawings, electrical power schematics, and control schematics in the operations & service manual.

Mechanical

Scope

Pump station shall be a completely skid mounted submersible pump station built by a single manufacturer. All equipment including but not limited to pumps, motors, valves, instrumentation and controls shall be mounted on a common structural steel base to form a complete operating pumping station.

Station Base

The pump station base shall be designed and fabricated to provide proper structural support for all attached equipment. The base shall supply sufficient rigidity to withstand the stresses of reasonable and competent transportation

to site, off loading, installation, and operation. Main structural members shall be constructed from medium weight channel or I-beam steel. Provisions shall be made in the station base for off-loading and handling the station at the site of installation. Base shall include 1/4" checkered deck plate and 1" steel plate mounted under pump discharge heads. All 1/4" deck plate and 1" steel plate shall be 100% seal welded to main structural members. Skip welding is not acceptable. Wet well access shall be covered by removable 1/4" deck plate.

Discharge Piping

All piping shall be constructed from ASTM A105 schedule 40 pipe or heavier as required to maintain a 3 to 1 pressure safety factor (including 1/16" corrosion allowance). All piping shall be hydrostatically tested to 150% of maximum shutoff pressure.

Paint

Structural steel and piping shall be commercially sand blasted and evenly coated with 2 1/2 to 3 mils epoxy primer. A 1 1/2 to 2 mil finish coat of polyurethane shall then be applied. The control panel shall be dip cleaned, acid etched and neutralized, iron phosphate coated and painted with a finish coat of 1/12 to 2 mils of polyurethane.

Bolts

All bolts used in the assembly of the pumping system shall be GR5 cadmium plated to retard corrosion.

Pump Check Valve

Pump check valves shall be bolted directly to the pump discharge heads and sized per the technical data sheet. They shall of the silent operating type that begin to close as forward velocity diminishes and be fully closed at zero velocity preventing flow reversal. Valve bodies shall be cast from grade 35 cast-iron or better and shall be free from blow holes, sand holes, and other impurities. The valve design shall incorporate a center guided, spring loaded pop up, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 PSI.

Pump Isolation Valves: Discharge

Pump isolation valves shall be of the butterfly type with grooved ends to provide for expansion and vibration dampening and a lever operator. They

shall be sized as shown in the technical data sheet. Valve body and cover shall be made of cast iron. Valve shall be rated to 300 PSI.

Air Release Valve

A properly sized air release valve shall be installed on top of the stuffing box mounting plate of each discharged head. Valve shall function to release separated air (generated by the starting of the pumps) to atmosphere. Discharge of air release valve shall be vented back to the wet well. Valve shall have cast iron body and cover with stainless steel internal trim, and a button to prevent malfunctions due to corrosion.

Pressure Relief Valve

A pilot operated modulating relief valve shall be included and sized per the technical data sheet. The valve shall be set 7 to 10 PSI above operating pressure and shall relieve when inlet pressure exceeds spring setting on pilot. Valve shall be quick opening and slow closing to minimize surging. Discharge of relief valve shall be piped back to wet well. Valve body shall be cast iron with inlet and outlet flanges, and shall be rated for 200 PSI. A wafer strainer shall be installed in the inlet side of the valve body to provide clean water to the CRL pilot. A wafer style butterfly valve shall be installed on the inlet of the relief valve. Specifications for this isolation valve shall be the same as for the station isolation valve found later in the specification.

Pressure Gauge

A pressure gauge shall be mounted on the discharge header with an isolation ball valve. All gauges shall be silicon filled to reduce wear due to vibration. Accuracy shall be within 2% Gauge diameter shall be 3 1/2” minimum. Range shall be at least 30% higher than the highest pressure attainable from the pumps at shutoff head conditions. Stainless steel back & bronze internal.

Station Isolation Valve

Station isolation valve shall be installed on the discharge of the pump station to completely isolate the pumping system form the irrigation system. Valve shall be of the lug style butterfly type. Valve shall have one piece body cast from cast iron

Electrical

Scope

To provide complete instrumentation and controls to automatically start, stop the pump along with provision of full alarms and safety features needed to protect the equipment and irrigation piping system.

Control Enclosure

Controls shall be housed in an enclosure with integral latches. The control enclosure shall be constructed of 12 gauge steel and the back plate assembly shall be constructed of 12 gauge steel. The enclosure shall be painted as specified in the paint specification listed under relevant section. All indicating lights, reset buttons, speed potentiometer, selector switches and the operator interface device shall be mounted on enclosure door. All internal components shall be mounted and secured to the removable back plate assembly. A closed type cooling system shall be included to cool the enclosure and reject heat. Open type cooling systems allowing outside ambient air to enter the panel are not acceptable. No water line connections shall be permitted inside of the control enclosure.

Lightning and Surge Arrestor

All electrical equipment shall be protected by a secondary surge arrestor to suppress voltage surges on incoming power. Unit shall have maximum clamping voltage of 1500 volts.

Main Disconnect

A non-fusible main disconnect shall be provided to completely isolate all control and motor starting equipment from incoming power. Main disconnect shall have a through the door operator, and shall be sized as shown in the technical data sheet.

Control Power

Power for the controls shall be provided by a control power transformer which shall provide 120 volt, single phase power for the pumping system control operation. Control power transformer shall not be used for any other external load. The control power transformer shall be protected on the primary side by control limiting fuses of adequate size and voltage rating. All control components shall be protected by time delay circuit breakers of adequate size.

Motor Starting Equipment

Unless modified, all motor starters for the pumping station shall be mounted on a single back panel in a single enclosure as specified in relevant section . Motor starters shall be rated for a minimum of 1,250,000 operations.

Flow Meter

The pump station shall have a flow sensor installed which shall provide the pump station flow rate and total flow. A flow meter run shall be included with a minimum of 5 pipe diameters straight run upstream and 2 pipe diameters downstream for proper meter accuracy. Meter run shall be sized as shown in technical data sheet.

Codes

All equipment and wiring shall be mounted within the enclosure and labeled for proper identification. All adjustments and maintenance shall be able to be done from the front of the control enclosure. A complete wiring circuit and legend with all terminals, components, and wiring identification shall be provided. Main disconnect shall be interlocked with door.

Installation

Start Up

When discharge piping, electrical connections, and electrical inspection have been completed, the pump station manufacturer shall be contacted for start up. A minimum one week notice shall be given a running test of normal start and stop, and fully loaded operating conditions. During this test, each pump shall demonstrate its ability to operate without undue vibration, or overheating and shall demonstrate its general fitness for service. All defects shall be corrected and adjustments made at the expense of the pump station manufacturer. Test shall be repeated until satisfactory results are obtained. Start up assistance shall be provided but shall be limited to one 8 hour day unless otherwise specified.

Warranty

The manufacturer warrants that the water pumping system or component shall be free of defects in workmanship for one year from date of authorized start-up but not later than fifteen months from date of manufacturer’s invoice.

Provided that all installation and operation responsibilities have been properly performed, manufacturer shall provide a replacement part or component during the warranty life. Labor charges (i.e. removal or replacement of pumps & motors) are excluded from this warranty except manufacturer shall be

responsible, subject to standard rate limitations, for cost of part removal, installation, and transportation for a failure occurring within ninety days of authorized and registered start-up. Repairs done at manufacturer's expense must be pre-authorized. The start-up certificate must be on file with manufacturer to activate warranty. Upon request, manufacturer shall provide advice for trouble shooting of a defect during the warranty period.

Manufacturer uses only high quality material. As with any mechanical or electrical device, some preventative maintenance efforts are required to enhance service life. The customer is encouraged to establish a methodical maintenance service program to avoid premature failure. Manufacturer supports a wide network of technical service agents and recommends they be utilized for service. Because of varied conditions beyond the control of manufacturer, this warranty does not cover damage under the following condition or environment unless otherwise specified in writing:

1. Default of any agreement with manufacturer.
2. Misuse, abuse, or failure to conduct routine maintenance
3. Handling any liquid other than irrigation water.
4. Exposure to electrolysis, erosion, or abrasion.
5. Presence of destructive gaseous or chemical solutions.
6. Over voltage or unprotected low voltage.
7. Unprotected electrical phase loss or phase reversal.

The foregoing constitutes manufacturer's sole warranty and has not nor does it make any additional warranty, weather express or implied, with respect to the pumping system or component. Manufacturer makes no warranty, whether express or implied, with respect to fitness for a particular purpose or merchantability of the pumping system or component. Manufacturer shall not be liable to purchaser or any other person for any liability, loss, or damage caused or alleged to be caused, directly or indirectly, by the pumping system. In no event shall manufacturer be responsible for incidental, consequential, or act of God damages nor shall manufacturer's liability for damages to purchaser or any other person ever exceed the original factory purchase price.

Maxi Flush Automatic screen filtration systems:

The pump station manufacturer shall provide a Maxi Flush automatic self cleaning filter mounted and wired on the pump station. The filter model number and style shall be a type as specified in the technical data sheet.

The differential pressure setting (to initiate backwash) and the backwash cycle time shall be adjustable.

A central hydraulically operated differential pressure switch with an integral hydraulic to electric converter (monostat) located on the filter shall operate with the control panel to initiate the back flush mode of operation for the filter. The differential pressure switch shall serve to sense a preset differential pressure of 3,5 or 7 psi from the filter inlet and outlet pipes.

Upon sensing the preset differential pressure that develops, the differential pressure switch shall activate the monostat which provides an electric signal to the control panel to begin the backwash. The backwash cycle shall require a minimum flow rate of GPM (at the minimum inlet pressure), and the filter shall continue to provide filtered water to service during the entire backwash cycle.

The filter housing shall be fabricated of welded steel construction and be designed for a maximum operating pressure of 150 psi. Th exterior and interior wetted surfaces shall be epoxy coated.

The filter screen shall be constructed of stainless steel and shall be adequately supported to withstand the full differential pressure of the housing design.

There shall be a 6” flanged “man-hole” type connection at the inlet pipe on the filter to permit immediate access to the internal components.

The bristles on the flushing brush shall be of stainless steel construction and 0.2 mm diameter.

The stainless steel filter shall be interchangeable with a minimum of 75 screen mesh. These screen shall be replaceable through a flanged connection in the filter housing. Screen changes shall be made without the removal of the filter from its piped connection (installed position).

The filter shall be designed for operation in either a horizontal or vertical installed position in the pipe run.

The filter shall be designed to permit integral operation of multiple units installed either in series for process water containing high level of suspended material and/ or in parallel for slow rates in excess of the capacity of a single unit. The filter flush line shall be piped back to the supply reservoir by others.

Discharge log

The pump station manufacturer shall supply the discharge pipe connecting the pump station discharge to the irrigation main line. The discharge pipe shall be painted the same as the main pump station and shall be size per the technical data sheets.

FIELD DRAINAGE

Field Drainage consists of providing and installing drainage pipe as specified in Drainage covered under Greens and Bunker Construction. In general, these areas shall be drained by field drains which consist of embedding a minimum of 100mm perforated drainpipe in a trench 200mm wide and 300 mm deep, bedded and back-filled with 6mm to 9mm washed gravel (the same gravel used in greens construction specifications). A PVC drop inlet structure shall accept the surface drainage water at a low point in the localized area and carry the water to an acceptable discharge point.

Sumps shall be constructed as indicated on the plans and as directed in the field to enhance drainage of the golf course.

GRASSING

General

The work covered by this section consists of furnishing all labor, equipment and materials to perform, and of performing, all operations in connection with sprigging and completion thereof, in strict accordance with the Specifications and applicable Drawings. The grass species shall be defined with these specifications and on the Plan Drawings. The following is a summary of operations:

1. Limits of all grassing areas as staked by the Consultant / engineer in charge and shown on the Plans.
2. Tillage, plowed or disked to a 150mm depth
3. Application of basic fertilizer, and pesticides as prescribed by the consultant based on the lab tests and recommendations.
4. Disking and dragging.
5. Removal of stones and debris to a 3/4” diameter
6. Final preparation with smoothing harrow or drag.
7. Sprigging

8. Compaction

As far as possible grassing shall commence only after the irrigation system has been installed and is operational.

Sprigging

All sprigs shall be freshly cut and in excellent viable condition upon arrival at job site. All sprigs shall be certified as to genetic purity by the Consultant / engineer in charge as to freedom from pest and disease.

Preparation of Areas to be Sprigged

Clearing

Prior to or during grading and tillage operations, the ground surface shall be cleared of stumps, stones larger than 3/4" in diameter, roots, cable, wire, grade stakes, and other materials that might hinder proper grading, tillage, sprigging, subsequent maintenance operations.

Topsoil

All areas of fill, i.e. trenches, mounds, etc., shall be compacted and settled as specified in these specifications before any topsoil is placed on areas to be sprigged. Before topsoil is spread, the sub-grade shall be scarified to a depth of 100mm to insure proper bonding with applied topsoil if it has been compacted due to weather or equipment. The area shall be leveled and raked free of stones larger than one (1") in diameter and other debris. Topsoil shall be spread to a depth of 150/300mm as applicable.

Grading

Previously established grades, as shown on drawings of areas to be treated, shall be maintained in a true and even condition. Maintenance shall include necessary repairs to previously graded areas. When grades have not been established, areas shall be shown on the drawings, and surfaces shall be left at the prescribed grades in an even and properly compacted condition so as to prevent the formation of depressions where water shall stand.

Tillage

After areas to be treated have been brought to the grades shown on the drawings, they shall be thoroughly tilled to a depth of at least 150 mm but not more than the depth of the topsoil layer by plowing, disking, harrowing, or other approved methods until the condition of the soil is acceptable. Work shall be performed only during periods when beneficial results are likely to be obtained. When conditions are such, by reason of drought, excessive

moisture, or other factors, that satisfactory results are not likely to be obtained, the work may be stopped by the NRL or the Consultant / engineer in charge and shall be resumed only when directed. Undulation or irregularities in the surface that would interfere with further construction operations or maintenance shall be leveled before the next specified operation.

Application of Fertilizer & Soil Amendments.

Fertilizer

Basic fertilizer (12 32 16) shall be distributed uniformly at a rate of 18 gms./m2 over the areas to be sprigged as indicated on the drawings within 24 hours of the application.

Planting Sprigs

Planting shall be defined as the insertion of 100 live sprigs per square meter.

After all areas to be planted have been fertilized, these areas shall then be "floated out" and put in soft condition for planting. The final seedbed must be smooth and sufficiently soft in order for the grass to be planted therein. The condition of the seedbed in all areas shall be approved by the Consultant / engineer in charge prior to planting. All areas to be grassed shall have soil moisture levels necessary for sprig survival and growth.

All grass sprigs shall be planted by shredding the grass at the time of harvest and by delivering it to the site. The grass shall be planted by evenly distributing the sprigs. All areas shall be rolled with a smooth type roller after planting. Stolons shall be broadcast evenly over these areas and chopped in lightly by shovel, hoe or other hand tool which leaves grade unchanged.

Where practical or necessary, sprigging shall be at right angles to the slopes in order to minimize erosion of these areas. The Consultant / engineer in charge shall be the final judge as to the condition of all planted areas after seeding and sprigging and these areas shall meet the Consultant / engineer in charge's approval.

Maintenance of the Planted Area

Immediately after all areas have been planted, the planted areas sufficiently watered to seal the soil around the sprigs. This initial watering is of extreme importance. Sprigs shall not be allowed to go without water for more than one hour after planting.

Erosion damage, or any other type of damage not caused after planting shall be set right.

Satisfactory Sprouting

Sprouting shall be evidenced when a sprig produces new leaf growth. Any areas not demonstrating satisfactory sprouting shall be replanted. Since the proper growth and cultivation of turfgrass is dependent upon a variety of factors beyond control, failure of planted areas to demonstrate satisfactory sprouting by Acts of God, extremely unusual weather conditions (meaning 20% beyond normal range in temperature and 200% beyond normal range in rainfall), and/or unusual or uncontrollable disease or insect attacks shall be replanted.

Maintenance of the grass on an individual golf hole basis until the handing over of the complete project and further upto the completion of the defects liability period shall be the responsibility of the contractor.

Greens & Tees

After fertilizers have been applied, all surfaces shall be “floated out” using a Toro sand-pro type machine or equivalent with a keystone type drag mat or other suitable implement. Extreme caution shall be exercised in this operation so as not to bring foreign matter into the putting surface.

Greens and tees shall be treated with basic fertilizer (12 32 16) at a rate of 18 gms./m2 and STEP (Scotts Trace Element Package)or equivalent at a rate of 50 gms./m2 and shall be incorporated into the top 3” of the soil profile with a Sand-pro or other suitable equipment within 24 hours of the application. An 18 gms./m2 application of basic fertilizer (12 32 16) shall be applied at the time of sprigging. All materials and methods of application under this paragraph shall be subject to the Consultant / engineer in charge’s approval.

After all specified areas have been fertilized, these areas shall then be “floated out” to the satisfaction of the Consultant / engineer in charge and put in a soft condition for planting. The final seedbed shall be smooth and sufficiently soft in order for the seeds or sprigs to be planted therein. The final surfaces shall also be free from water-holding depressions or pockets. The condition of the seedbed and the putting surfaces shall be approved by the Consultant / engineer in charge prior to planting.

Planting

Reference is hereby made to the “Sprigging Section” planting. All applicable portions of the referenced section shall be deemed as specified for this

section unless specifically modified or revoked herein. The green putting surfaces shall be hand planted.

The Consultant / engineer in charge shall be the final judge as to the condition of all planted areas after sprigging and these areas shall meet the Consultant / engineer in charge's approval.

Satisfactory Germination and Sprouting.

Since the proper growth and cultivation of turfgrass is dependent upon a variety of factors in case of failure of planted areas to demonstrate satisfactory sprouting if operations are impaired by Acts of God, extremely unusual weather conditions (meaning 20% beyond normal range in temperature and 200% beyond normal range in rainfall) and/or unusual or uncontrollable disease or insect attacks, they shall be re-sprigged

PLANTING

General

Scope

The scope of this section includes preparation of planted areas and the supply, planting, protection and maintenance of shrubs of the species and size indicated on the drawings, specified or listed in the Bill of Quantities. This section shall be read in conjunction with all other relevant sections of the Specification.

Climatic Conditions

All work shall be carried out during the appropriate seasons and in soil and weather conditions that are suitable for the relevant operations.

Submittals

The following information shall be submitted:

Data:

a) Manufacturers certified analysis of all standard products, including fertilizers.

b) A certified analysis by an approved laboratory for non-standard product.

c) Certificates confirming the origin, size and age of all plant material.

Schedules:

Schedules showing program of implementation for each type of landscape work shall be submitted to the Consultant/engineer in charge. If necessary, revised planting schedules shall be submitted with documentation of reasons for the revision.

Samples:

Samples of all materials to be used in this contract shall be submitted for approval. Three approved samples of each plant shall be provided. The approved samples shall be the quality standard for the material and its placement.

Rubbish

All rubbish and litter as it accumulates within the landscape boundary, shall be cleared and removed daily. The areas shall be kept in a clean and tidy condition with all driveways, paths, edges, kerb gutters, and gullies swept and kept clear of debris at all times. All rubbish and debris shall be removed from site.

Oil and Petrol Storage

All oil and petrol containers are to be kept in suitable sheds provided and all regulations regarding the storage of inflammable liquids shall be adhered to. If any areas of soil are affected by oil or petrol spillage, the contaminated soil shall be dug up until uncontaminated ground is reached, and removed from site and such areas made good as directed.

Approved Chemicals

All chemicals to be used shall be non-toxic to human beings, birds and animals and shall be stored separately, handled and supplied strictly in accordance with the manufacturer's printed instructions.

Existing Services

The location of all underground services shall be marked prior to commencing excavation works. Any work is confined spaces, around existing trees or in the vicinity of major utility services shall be executed by hand.

GROUND PREPARATION OF PLANT MATERIALS

Description

The preparation of the ground shall include for all necessary excavations, backfilling and watering. The ground shall be considered very saline. There shall be no contamination of the soil in areas to receive planting in respect to petrol, oil or other toxic chemicals, either before or during the works.

Pit Sizes

Pits for shrubs shall be excavated to the following size:

Trees	0.60m x 0.60m x 0.60m deep
Shrubs	0.30m X 0.30 m X 0.30m deep

Mass Planting(Ground covers)

Where shrubs are mass planted (i.e. more than 1 per m2) the whole area shall have a depth of 500 mm of planting soil, and all ground cover shall have a depth of 300mm of planting soil.

Loosen Sub-Grade

The bottom of all planting pits/ areas shall be loosened with a fork to a depth of 150 to 200mm

Planting Medium

Planting Medium for planting shrubs shall be with the following ingredients added at the time of planting.

Soil:

The soil shall consist of 80% sand and 20% soil from an approved borrow pit. Soil amendments shall be as follows or as directed by laboratory test results and recommendations:

Manure:

Tree/Shrub Pit:	0.5 Bag per pit

General Fertilizer:

Tree/Shrub Pit	100 gms. per pit.

Fertilizers

Procedures for additives, amendments and fertilizers shall be as specified below. Empty bags or containers shall be counted on site by the Consultant / engineer in charge and all empty bags or containers shall not be disposed of until counted.

Fertilizer shall be sulphur coated slow release compound fertilizer: 15+9+15+Fe 6% for shrubs test results or as recommended by laboratory.

Fertilizer shall be furnished in standard containers with the name, weight and guaranteed analysis of the contents clearly marked.

When a mixed fertilizer is specified, the first number shall represent the minimum percentage of soluble nitrogen, the second number shall represent the minimum percentage of available phosphoric acid and the third number shall represent the minimum percentage of water soluble potash.

Manure

The decomposed animal manure shall comprise a mixture of fully fermented pre-dried cow or chicken manure with minimum N, P, K percentage 2-2-2 and pH 6.0-7.5. Sludge waste product may be used as a substitute subject to laboratory testing and approval for suitability as an amendment by the Consultant / engineer in charge.

PLANT MATERIAL

General

All plants shall be of the size as specified or indicated in the Plan Schedule/Bill of Quantities at the time of delivery to the site.

Plants shall be true to type. All planting stock shall be well-balanced and well formed, sound, vigorous, healthy and free from disease, sun scald, abrasion, harmful insects or insect eggs and with a healthy, unbroken root system filling their containers but not root-bound. All plants shall be container grown. All planting shall be free of pests, viruses etc.

Protection During and After Delivery

All plant material shall be delivered in closed vehicles or in open vehicles with the entire load property covered in transit for protection from dying winds. They shall be planted immediately upon delivery. If not, then the plant

materials shall be stored in a sheltered compound, and be maintained and watered to good horticulture standards until planted on site.

Inspection

The Consultant / engineer in charge may request inspection at the source of plants before delivery to the site and he reserves the right to reject any plant material that does not meet the quality standards specified.

LIST OF PLANT MATERIAL TO BE USED

A. GRASSING

1.	**GREENS**	**:**	**TIF DWARF**
2.	**FAIRWAYS AND TEES**	**:**	**TIFWAY 419**
3.	**ROUGHS**	**:**	**TIFWAY 419**

B. TREES

1. **Alistonia scholaris**
2. **Polyalthia longifolia**
3. **Golden bottle brush**
4. **Palms – species**

C. SHRUBS

1. **Ficus panda**
2. **Ficus nuda**
3. **Hibiscus rosa sinensis**
4. **Duranta variegated**
5. **Hamelia patens**
6. **Plumeria alba**
7. **Yucca – species**
8. **Fircaria species**

GROUND COVERS

1. **Lantana sellowiana**
2. **Sedum prostratum**

3. **Irisine**
4. **Wadelia**
5. **Jacomentia**
6. **Ruellia macarantha**
7. **Alternanthera species**
8. **Golden duranta**

PLANTING OPERATIONS

Soil Grading and Preparation

Subsoil shall be excavated to achieve tolerances specified for finished levels of soil, and when reasonably dry and workable, graded to smooth, flowing contours with all minor hollows and ridges removed. Non-cohesive, light subsoil shall be loosened with rippers 300mm deep.

All perennial weeds shall be treated with herbicides and the period of time recommended by the manufacturer shall be allowed to elapse before grading. All weeds, rocks and other debris shall be removed and disposed off. Finished ground level adjoining buildings shall be kept below the level of the damp-proof course.

Handling and Transportation of Plants

Plant material shall be lifted or moved in such a manner that the roots are not disturbed. Plant material shall be lifted or moved by handling the container and not the above ground portion of the plant. Root system of all plants shall not be allowed to dry out at any time and shall not be exposed to excessive or artificial heat or to freezing temperatures. During transportation, all plants shall be packed adequately to ensure protection for climate or physical inquires. Tarpaulins or other covers shall be placed over plants when they are transported by trucks or in open freight cars. All plants shall be treated with anti-desiccant prior to transportation.

On-Site Acclimatization and Storage

All plant materials shall be delivered to site for acclimatization within the first two months of the contract period.

Planting Timing

Planting shall take place before 10.00 hours and after 16.30 hours but can be carried out at other times if approval is given by the Consultant / engineer in charge, Prior to planting, all grading and ripping, paving, laying of services and other building work shall be complete, the irrigation system shall wherever possible, be operational and soil brought to field capacity and all areas to be planted shall have been soiled and allowed to settle over a period of one month.

Planting Medium

Specified and/or laboratory recommended soil additives shall be mixed with sand and soil mix at the rates specified. The soil shall be mixed mechanically by an approved method to create a homogenous mixture. Application rates for ameliorates shall be checked and approved by the Consultant / engineer in charge prior to mixing each batch.

Planting Sequence

The sequence of planting shall be as follows:

Grade soil as specified

Stake out the outline of planting areas and individual tree and shrub locations

Excavate planting areas and individual pits to the sizes specified. Excavated sub-soil shall be removed from site and shall not be mixed with the planting medium or used to form berms around the plants.

Fill planting pit with irrigation water and ensure the water can drain away.
Backfill pit/beds with approved planting medium in layers not exceeding 300mm and water compact. Allow for compacting/ subsidence by overfilling by 100mm. Once placed, the growing medium shall be covered with plastic sheeting and clearly marked to prevent disturbance until planting commences.

At the time of planting, a hole shall be made into the pit/bed large enough to take the plant root ball.. The planting hole shall be thoroughly watered prior to planting.

Plants shall be carefully removed from containers. Plastic pots shall be split with a knife and plants removed with all the soil intact around the roots. Care shall be taken not to damage the roots or foliage of the plants. The plant shall be placed upright in the hole.

Care shall be taken to ensure that the collar line (line of contact between the soil and stem) is at the same level as the surround ground.

Fill around the plant with planting medium in layers of 150mm, each layer separately firmed to eliminate all air pockets until final soil level is reached.
A circular watering basin slightly larger than the planting hole shall be formed.
During and after planting, the plants shall be thoroughly watered.

After planting, the area surrounding the plant shall be restored to finished grade and excess soils and rubbish disposed off properly.

Immediately after planting, all plants are to be pruned in accordance with accepted horticultural practices or as directed by the Consultant / engineer in charge. Pruning shall consist of carefully cutting back any damaged, dead or diseased branches and the removal of any weak or malformed growth, with the aim of forming each type of stock to the standard shape for its species. All pruning cuts greater than 20mm shall be treated with pruning paint as specified.

Check all plants one week after planting for signs of wind shake and loosening due to soil subsidence; firm and make goods as necessary.

Percolation test procedure:

One day prior to the test the pit/bed shall be filled with water. A marker bar is placed in the pit/bed before the test is performed.

The pit/bed is half filled with water and the level is indicated with tape on the marker bar. The test is monitored over a period of one hour. If the water level drops by 20mm or more within that time, the pit/bed passes.

If the pit fails the percolation test, boreholes shall be augured (2 no. per pit or 10m. spacing in planting beds. Tests shall be repeated at each 5m depth of borehole until the test is passed. After auguring, the boreholes shall be capped with wire gauze.

Percolation tests shall be carried out at a rate of 1 test per 50 plants. The Consultant / engineer in charge may instruct additional tests on an exploratory basis in the event of unsatisfactory percolation being evident.

Watering Requirements

Water shall take place at the following rates:

Shrubs - 15 litres/day/sq. metre

Grass - 12 litres/day/sq. metre

These amounts shall vary according to the weather but at all times the planting medium shall be kept moist and not allowed to dry out completely. Plants shall not be over-watered.

CLEAN UP

Procedure

As planting proceeds, all rope, wire, burlap, empty containers, rocks clods and all other debris shall be removed and not allowed to accumulate.

The site shall be kept tidy as possible at all times. All roads over which hauling operations have been conducted despite the type of surfacing, shall be kept clean and soil clods and debris left on the surface shall be removed.

After planting operations are finished, all paved areas which have become dirty or strewn with other materials shall be thoroughly cleaned by sweeping and washing, if necessary

COMPLETION AND WARRANTY

Completion

Substantial Completion:

At the date of Substantial Completion, all plants shall be in their specified position and condition.

Failure of plants:

Any plants that are found to be missing, defective or not in good condition at any time during the contract period and maintenance period shall be immediately replaced.

Maintenance after Planting:

Cultivation: During construction and upto the completion of the defects liability, the area around the plants shall be kept in a proper state of cultivation, free of weeds and well-aerated by regular hoeing. Also necessary is the control of insects, fungus, or other diseases by means of spraying with an approved insecticide or fungicide.

Firming In : The ground shall be firmed in if and when necessary to maintain plant stability.

Inspection: Regular inspection of stakes and ties with a view to replacement and adjustment shall be made where necessary.

Watering: Watering shall be carried out in accordance with Irrigation Watering Schedule of this specification. Watering shall take place in the evening or preferably in the cool of the early morning. Timings to be subject to seasonal conditions.

Early Pruning: Pruning in the early stages shall be limited to cutting out dead wood an cross branches.

Later Pruning: Pruning shall be carried in the later stages to reduce overcrowding, encourage new growth and generally keep a desirable effect as described hereafter.

COBBLES, BOULDERS, SAND AND SANDY WASTE

Cobbles

The cobbles shall be 250mm - 350mm stone from local source. The mixture shall be random.

Boulders

Boulders shall vary in size from 2’ to 6’ and shall be well formed and obtained from approved source. These shall be suitably placed at areas in waste bunkers and around the lakes as indicated by the Consultant / engineer in charge.

SAND/ COARSE SAND

All Sand used (other than bunker sand) shall conform to Grading Zone III as provided in CPWD specifications.

CIVIL WORKS :

Civil works that are incidental to the construction of the golf course viz.Pump/machinery foundations etc shall be undertaken as per CPWD specifications.

MAINTENANCE OPERATIONS TO BE UNDERTAKEN DURING CONSTRUCTION AND UPTO COMPLETION OF DEFECTS LIABILITY PERIOD.

The Golf Course shall be maintained to a high standard and the maintenance costs shall include all labour, services, materials and costs of administration, supervision etc. The machinery as provided in the henceforth mentioned list shall be provided by NRL.

Since Golf Course is a service industry, every effort shall be made to ensure that all employed for its maintenance adopt an attitude of perfection and discipline and ensure that no maintenance operations adversely affect the playing of Golf. Similarly each employee involved in the maintenance shall present himself in a neat and tidy manner.

Machinery used for the maintenance of the Golf Course shall be kept in a neat and presentable manner. Noise emanating from machinery shall not exceed manufacture's nor health and safety guidelines.

Smoking shall be prohibited within the maintenance facility.

Any rubbish collected from the Golf Course is not to be disposed of in any manner on site. Rubbish is to be removed from the site and disposed of in a manner approved by the relevant authorities.

A minimum full time staff shall be employed for the Golf Course apart from the following:

i) An experienced Golf Course Superintendent.

ii) Experienced and qualified machinery operators

iii)Additional staff/laborers (qualified or non qualified)

Staff shall be expected to work a minimum of 8 hours.

Maintenance shall be provided w.r.t. the following areas :

General site works

a) Fence lines and Golf Course surrounds

b) Lake and its components

c) Course furniture if any

d) Irrigation systems

e) Drainage system

f) Maintenance area

Golf Course works

a) Greens and green surrounds
b) Tees
c) Bunkers and waste areas
d) Fairways
e) Roughs

Irrigation works

Miscellaneous activities

a) Record rainfall readings
b) Record power usage
c) Record maintenance meetings schedules

<u>OPERATIONS TO BE UNDERTAKEN:</u>

1. GENERAL SITE WORKS

a) **Fence lines and course surrounds**(external fence to road) viz. the area between the fences around the Golf Course and any roadways shall be mown as required and any rubbish in this area shall be removed to maintain a neat and tidy appearance at all times. Weed control along all boundary fences shall be ensured

b) **Lake/water body** shall be maintained in a clean, clear and tidy fashion. Grass is to be mown to the waters edge and trimmed when necessary. The condition of water and its level shall be monitored and maintained constantly. Testing of water in the lake shall be undertaken every twelve months. A report on the testing of the Lake water shall be made available to the Consultant/Engineer in charge as shall any recommendations with regard to the maintenance of water quality.

Should the regular testing show greater than normal levels of any toxic materials the Consultant/Engineer in charge shall be informed at once.

c) Course furniture which is provided by NRL shall be maintained in a neat and tidy manner and that any damage is reported to the Engineer in charge who shall be responsible for repairs.

d) Drainage systems shall be regularly inspected, cleaned and flushed. This shall be carried out a minimum of once per year.

a) Mowing/Rubbish Removal

3) GOLF COURSE WORKS

a) GREENS

Maintenance of all greens on the Golf Course shall be to an “International Standard”. All tests shall be carried out on the greens every six months to monitor the pH, salt and nutrient levels within the green. A copy of the results of these tests shall be passed on to the Consultant/Engineer in charge. Should any problems occur on the greens (insect, disease etc.) that cannot be quickly identified and dealt with a suitable sample of the problem shall be immediately sent for testing to identify the problem and thus a solution. A copy of any such test results shall be immediately given to the Consultant / engineer in charge.

i) Mowing

Greens shall be mown at a height to be agreed with the Consultant/Engineer in charge. The greens shall be mown utilizing a motorized greens mower suited to the task. Grass clippings shall be removed from the green and disposed of in a proper manner (spread out evenly and not in a pile).

Greens shall be mown a minimum of once per day four times per week. At times the greens may require double cutting or extra cutting when preparing for tournaments or special events.

ii) Fertilizing

Suitable nutrient levels within the green shall be maintained to ensure a quality turf surface and good root system. As part of the maintenance program a fertilizing program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to.

iii) Fungicide Applications

Control of all fungal problems that could occur within the greens shall be ensured. As part of the maintenance program a suitable fungicide prevention program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to.

Adequate chemical supplies to deal with any outbreak of fungal disease on the greens shall be stocked at all times.

iv) Insecticide Applications

Control of all insect problems that could occur within the greens shall be ensured. As part of the maintenance program a suitable insecticide prevention program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to. Adequate chemical supplies to deal with any outbreak of insect damage on the greens shall be maintained at all times.

v) Weed Control

It shall be ensured that the greens are kept in a weed free manner. Adequate chemical supplies to deal with any weed problems shall they appear shall be maintained at all times.

vi) Dethatching

As part of the maintenance program details on dethatching of the greens shall be made, though dethatching shall be carried out on an “as needs” basis.

vii) Wetting Agent Applications

As part of the maintenance program details of applications of wetting agents to be applied to the greens shall be made, though applications shall be carried out only on an “as needs” basis.

viii) Topdressing

Topdressing of the greens (inclusive of supply of approved sand) as a light dressing (or dusting) in order to develop and maintain a putting surface of desired quality shall be carried out on a regular “as needs” basis

ix) Irrigation

Maintaining of proper moisture levels within the root zone of the greens is important and adequate irrigation shall be done by using the Irrigation system so as to maintain moisture levels. Excessive irrigation shall not occur under any circumstances.

x) Hand Watering

The Irrigation system has a manual quick coupler for hand watering at each green. To maintain moisture levels watering may be required on a “as need basis” or as a temporary action should the automatic system not be operational. The watering shall be carried out as required.

xi) Flush Drainage System

Regular inspection, cleaning and flushing of the drainage system on the greens shall be carried out a minimum of two times per year.

xii) Lime Application

A proper pH level within the root zone of the greens shall be maintained. Application of lime as indicated by the soil test results shall be applied on a “as needs” basis to maintain the pH.

xiii) Other Chemical Applications

Any other chemical applications that may be required due to the soil testing results or as part of a weed control or other program (eg. Iron Sulphate, hormone, growth retardant etc.) on the greens shall be added on a regular basis.

xiv) Pin Placements

Changing of putting cups (holes) and the correct placement of pins for the purposes of golf play shall be undertaken on a weekly basis. The pin placement “style” is to be agreed with the Consultant / Engineer in charge and carried out as required. Putting cups and flags are to be maintained to a high standard at all times.

b) TEES

Maintenance of all Tees on the Golf Course shall be to an “International Standard”. All tests shall be carried out on the tees every six months to monitor the pH, salt and

nutrient levels within the tee. A copy of the results of these tests shall be passed on to the Consultant/Engineer in charge. Should any problems occur on the greens (insect, disease etc.) that cannot be quickly identified and dealt with a suitable sample of the problem shall be immediately sent for testing to identify the problem and thus a solution. A copy of any such test results shall be immediately given to the Consultant/Engineer in charge.

i) Mowing

Tees shall be mown a minimum of twice per week at a height to be agreed with the Consultant/Engineer in charge. Tees shall be mown by a lightweight Tees ride-on mower designed for the task.

ii) Fertilizing

Suitable nutrient levels within the tee shall be maintained to ensure a quality turf surface and good root system. As part of the maintenance program a fertilizing program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to.

iii) Fungicide Applications

Control of all fungal problems that could occur within the tees shall be ensured. As part of the maintenance program a suitable fungicide prevention program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to.

Adequate chemical supplies to deal with any outbreak of fungal disease on the tees shall be stocked at all times.

iv) Insecticide Applications

Control of all insect problems that could occur within the tees shall be ensured. As part of the maintenance program a suitable insecticide prevention program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to. Adequate chemical supplies to deal with any outbreak of insect damage on the tees shall be maintained at all times.

v) Weed Control

It shall be ensured that the tees are kept in a weed free manner. Adequate chemical supplies to deal with any weed problems shall they appear shall be maintained at all times.

vi) Dethatching

As part of the maintenance program details on dethatching of the tees shall be made, though dethatching shall be carried out on an “as needs” basis.

vii) Wetting Agent Applications

As part of the maintenance program details of applications of wetting agents to be applied to the tees shall be made, though applications shall be carried out only on an “as needs” basis.

viii) Topdressing

Topdressing of the tees (inclusive of supply of approved sand) as a light dressing (or dusting) in order to develop and maintain a putting surface of desired quality shall be carried out on a regular “as needs” basis

ix) Irrigation

Maintaining of proper moisture levels within the root zone of the tees is important and adequate irrigation shall be done by using the Irrigation system so as to maintain moisture levels. Excessive irrigation shall not occur under any circumstances.

x) Hand Watering

The Irrigation system has a manual quick coupler for hand watering at each tee. To maintain moisture levels watering may be required on a “as need basis” or as a temporary action should the automatic system not be operational. The watering shall be carried out as required.

xi) Flush Drainage System

Regular inspection, cleaning and flushing of the drainage system on the tees shall be carried out a minimum of two times per year.

xii) Lime Application

A proper pH level within the root zone of the tees shall be maintained. Application of lime as indicated by the soil test results shall be applied on a “as needs” basis to maintain the pH.

xiii) Other Chemical Applications

Any other chemical applications that may be required due to the soil testing results or as part of a weed control or other program (eg. Iron Sulphate, hormone, growth retardant etc.) on the tees shall be added on a regular basis.

xiv) Tee markers

Regular movement of tee markers shall be undertaken, the frequency of which shall be at the instruction of the Consultant/Engineer in charge.

C) FAIRWAYS

Maintenance of all Fairways on the Golf Course shall be to an "International Standard". All tests shall be carried out on the fairways every six months to monitor the pH, salt and nutrient levels within the tee. A copy of the results of these tests shall be passed on to the Consultant/Engineer in charge. Should any problems occur on the greens (insect, disease etc.) that cannot be quickly identified and dealt with a suitable sample of the problem shall be immediately sent for testing to identify the problem and thus a solution. A copy of any such test results shall be immediately given to the Engineer in charge and Consultant.

i) Mowing

Fairways shall be mown at a height to be agreed with the Consultant/Engineer in charge. The Fairways shall be mown by a Fairways ride-on/ walk-behind mower designed for the task. As a guide it would be anticipated that fairways are mown a minimum of once per week or as required to maintain an adequate golf playing surface.

ii) Fertilizing

Suitable nutrient levels within the tee shall be maintained to ensure a quality turf surface and good root system. As part of the maintenance program a fertilizing program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to.

iii) Fungicide Applications

Control of all fungal problems that could occur within the fairways shall be ensured. As part of the maintenance program a suitable fungicide prevention program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to.

Adequate chemical supplies to deal with any outbreak of fungal disease on the fairways shall be stocked at all times.

iv) Insecticide Applications

Control of all insect problems that could occur within the fairways shall be ensured. As part of the maintenance program a suitable insecticide prevention program which shall be evolved by the Course superintendent along with the consultant / engineer in charge shall be adhered to. Adequate chemical supplies to deal with any outbreak of insect damage on the fairways shall be maintained at all times.

v) Weed Control

It shall be ensured that the fairways are kept in a weed free manner. Adequate chemical supplies to deal with any weed problems shall they appear shall be maintained at all times.

vi) Dethatching

As part of the maintenance program details on dethatching of the fairways shall be made, though dethatching shall be carried out on an “as needs” basis.

vii) Wetting Agent Applications

As part of the maintenance program details of applications of wetting agents to be applied to the fairways shall be made, though applications shall be carried out only on an “as needs” basis.

viii) Topdressing

Topdressing of the fairways (inclusive of supply of approved sand) as a light dressing (or dusting) in order to develop and maintain a putting surface of desired quality shall be carried out on a regular “as needs” basis

ix) Irrigation

Maintaining of proper moisture levels within the root zone of the fairways is important and adequate irrigation shall be done by using the Irrigation system so as to maintain moisture levels. Excessive irrigation shall not occur under any circumstances.

x) Hand Watering

The Irrigation system has a manual quick coupler for hand watering at each tee. To maintain moisture levels watering may be required on a “as need basis” or as a temporary action should the automatic system not be operational. The watering shall be carried out as required.

xi) Flush Drainage System

Regular inspection, cleaning and flushing of the drainage system on the fairways shall be carried out a minimum of two times per year.

xii) Lime Application

A proper pH level within the root zone of the fairways shall be maintained. Application of lime as indicated by the soil test results shall be applied on a “as needs” basis to maintain the pH.

xiii) Other Chemical Applications

Any other chemical applications that may be required due to the soil testing results or as part of a weed control or other program (eg. Iron Sulphate, hormone, growth retardant etc.) on the fairways shall be added on a regular basis.

d) BUNKERS AND WASTE AREAS

Bunkers shall be maintained to “International Standards” and it shall be ensured that the bunkers are maintained in a condition to the satisfaction of the Consultant/Engineer in charge. Only sand approved by the Consultant/ Engineer in charge shall be placed in the Bunkers.

i) Raking

Raking bunkers on the Golf Course shall be done constantly as required. As a guide it would be anticipated that Bunkers are raked a minimum of once per day, five days per week. Motorized bunker raking equipment provided shall be used for raking the bunkers. No damage shall be caused to the bunker edges should motorized raking occur. The bunker edges and batters shall be finished off by hand at all times. Bunker rakes for use by players shall be supplied at each bunker site.

ii) Weed Control

Bunkers shall remain in a weed free state at all times.

iii) Flush Drainage System

Flushing of drainage within the bunker a minimum of once per year shall be undertaken.

iv) Trim Edges

The edges of bunkers shall be kept in a neat and tidy manner at all times.

e) ROUGHS and LANDSCAPED AREAS

All areas shall be maintained in a neat and tidy manner. “Rough” and “Landscaped” Areas are defined as all turfed or landscaped areas outside of greens, tees, bunkers, fairways and lakes.

i) Mowing

Mowing the “Rough” Areas at a height to be agreed with the Consultant/Engineer in charge and at a frequency to ensure the areas are at all times neat and tidy shall be carried out.

ii Weed Control

It shall be ensured the “Rough” pathways, roads and fence lines are kept in a weed free manner. Adequate chemical supplies to deal with any weed problems shall they appear shall be maintained.

iii) Flush Drainage System

Regular inspection, cleaning and flushing of the drainage system in the “Rough” Areas (Where possible) shall be carried out a minimum of once per year. Although tree root invasion of drainage is to be prevented if possible any such invasion shall be removed as part of normal maintenance.

iv) Tree and plant care

Trees, shrubs and plants shall be pruned on an “as needs basis”. Removal of limbs damaged by storm, vandalism or disease shall be done. Trees shall be maintained in a healthy state and stakes if any shall be maintained in good order. Control of weeds around the base of trees to the extent of maintaining a neat and tidy appearance at all times along with root pruning of trees if required shall be carried out

4. IRRIGATION WORKS

Proper maintenance of all aspects of the Irrigation system shall be undertaken to ensure that it is in good working condition at all times.

i) Maintain Pump house

Pump house/s shall be maintained in a neat, tidy and secure manner. Regular minor maintenance of any pumps, valves, filters and electrical equipment shall be undertaken for ensuring that any inlet suction pipe from any lake or storage area is in good working condition free of debris.

ii) Maintain Bore/Bore Pump

Regular inspection and minor maintenance of any bore, bore pump or outlet pipes to any lake or storage area shall be undertaken.

iii) Trim Sprinkler Heads

Sprinkler heads shall be regularly trimmed so that turfgrass does not interrupt the correct operation of the sprinkler and appear neat and tidy at all times. Sprinkler heads shall be set level with the surrounding turfgrass surface.

iv) Test Irrigation System

Regular testing of the Irrigation system to ensure it remains in excellent working order shall be undertaken. Any faults with the Irrigation system or any components of such shall be immediately reported to the Consultant/Engineer in charge.

v) Maintain Valve Boxes or any Satellites

It shall be ensured that valve boxes and any satellites are maintained in a neat, tidy and secure manner. Valves shall only be operated using tools designed for the task and approved by the manufacturer. It shall be further ensured that valve boxes are set level to the surrounding turfgrass surface.

vi) Record Water Meter Readings

Recording of water used on a weekly basis through all meters including Bore, Pump house etc shall be made. These figures are to be passed on to the Consultant/Engineer in charge on a regular basis.

5. MISCELLANEOUS ACTIVITIES:

i) Record Rainfall readings

Daily, the amount of rainfall as per Meteorological Department standards in a gauge shall be recorded. Rainfall figures shall be submitted as part of regular reporting to the Engineer in charge.

ii Management Meetings

The Engineer in charge shall conduct regular weekly meetings to deal with matters concerning the Golf.

iii Record Power Usage

Full record of usage of power shall be maintained and shall be submitted to the Engineer in charge on a monthly basis.

13.0 PROJECT RECORD DOCUMENTS

An accurate (to scale with dimensions) As-Built Drawing shall be prepared indicating exact locations of all underground materials installed for drainage and irrigation.

Drain tile location in all greens and bunkers shall be diagrammed with all flushes and outlets located with dimensions from the sprinkler heads.

14.0 PROJECT CLEAN-UP

The premises and the golf course site shall be maintained in a reasonably neat and orderly condition free from accumulations of waste materials and rubbish during the entire construction period. Remove all crates, cartons and other flammable waste materials or trash from the work areas at the end of each working day.

Before acceptance of the job the site and premises shall be thoroughly cleaned.

Operating Instructions

Wiring diagrams, piping diagrams, installation instructions, parts lists and similar information shall be furnished for mechanical and electrical systems, all manufactured items and Vendor's equipment. All instructions w.r.t. Operating all mechanical and electrical systems shall be provided before final close out and handing over of the golf course post defects liability period.

List of makes of MATERIALS to be used for different works:

1.	STEEL	TISCO, SAIL RINL
2.	CEMENT	GUJRAT AMBUJA, ACC, BIRLA, JK
3.	PVC PIPE	SUPREME, FINOLEX

4.	PUMPS	KIRLOSKAR, CROMPTON, KISHORE
5.	GI PIPE	TATA, JINDAL (B CLASS)
6.	CHINAWARE	HINDWARE, CERA, PARRY
7.	ELECT. CABLES	CCI, PLAZA, ICI
8.	IRRIGATION EQUIPMENT	RAINBIRD, TORO
9.	CORRUGATED PVC PIPES /EQUIV	GWALIOR POLYPIPES LTD
10.	MCBs	L&T, HAVELS, MDS
11.	RCC PIPE	ISI APPROVED
12.	WATER PROOF COMPOUND	CICO, ACC, STP
13.	ELECTRICAL SWITCHES	ANCHOR, ROMA

TIME OF COMPLETION

The time for the completion of the project shall be 15 months after the physical handing of the clear site for exe